

Keysight Technologies

Bluetooth[®]

X-Series Measurement Application

N9081A & W9081A

Technical Overview



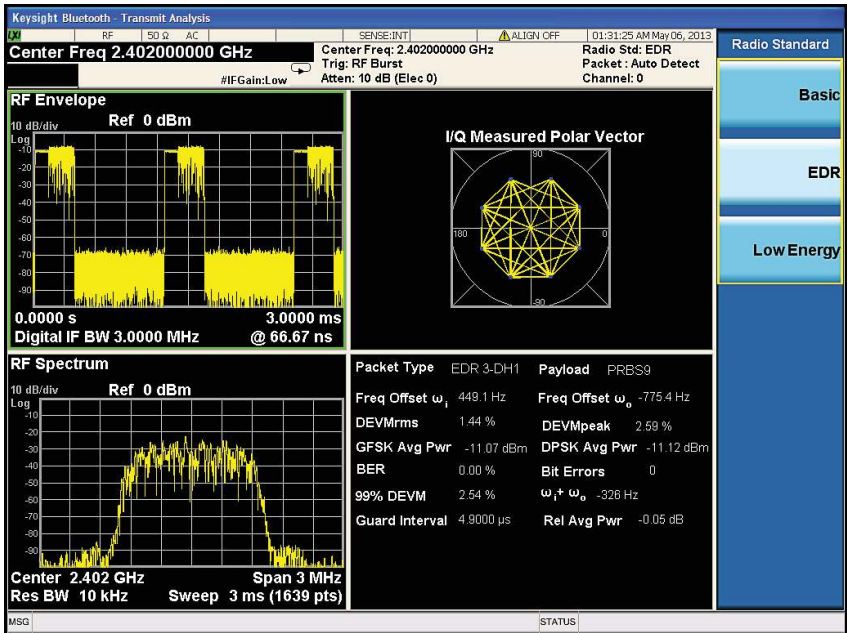
Introduction

- Measure *Bluetooth* RF transmitter performance, compliant to *Bluetooth* RF test specifications 2.1+EDR and Low Energy (RF-PHY.TS/4.0.0)
- Perform one-button tests with pass/fail limits per *Bluetooth* RF test specifications
- Use hardkey/softkey manual user interface or SCPI remote user interface
- Leverage built-in context sensitive help
- Move application between X-Series signal analyzers with transportable licensing

Bluetooth Measurement Application

The *Bluetooth* measurement application transforms the X-Series signal analyzers into standard-based *Bluetooth* RF transmitter testers by adding fast, one-button RF conformance measurements to help you design, evaluate, and manufacture your *Bluetooth* devices. The measurement application is standard-compliant to the *Bluetooth* Core Specification to verify your *Bluetooth* design with confidence and support manufacturing with a single application covering basic rate, EDR and low energy technologies for production.

The *Bluetooth* measurement application is just one in a common library of more than 25 measurement applications in the Keysight Technologies, Inc. X-Series, an evolutionary approach to signal analysis that spans instrumentation, measurements and software. The X-Series analyzers, with upgradeable CPU, memory, disk drives, and I/O ports, enable you to keep your test assets current and extend instrument longevity. Proven algorithms, 100% code-compatibility, and a common UI across the X-Series create a consistent measurement framework for signal analysis that ensures repeatable results and measurement integrity so you can leverage your test system software through all phases of product development. In addition to fixed, perpetual licenses for our X-Series measurement applications, we also offer transportable licenses which can increase the value of your investment by allowing you to transport the application to multiple X-Series analyzers.



Try Before You Buy!

Free 30-day trials of X-Series measurement applications provide unrestricted use of each application's features and functionality on your X-Series analyzer. Redeem a trial license online today: www.keysight.com/find/X-Series_trial

Bluetooth Technology Overview

Bluetooth is an open wireless technology standard for exchanging voice and data over short distances between fixed and mobile devices, creating personal area networks (PANs) with high levels of security. *Bluetooth* wireless technology eliminates the need for interconnection cables between information appliances.

The *Bluetooth* Special Interest Group (SIG), chartered to advance and promote *Bluetooth* wireless technology, has defined a test specification for conformance testing on the RF layer.

Bluetooth uses a radio technology called frequency-hopping spread spectrum (FHSS), and the design emphasis is on very low power, extremely low cost, and robust operation in the globally unlicensed, interference-dominated RF environment of the Industry, Scientific and Medical (ISM) band at 2.4 GHz. In Classic *Bluetooth*, which is also referred to as basic rate (BR) mode, the modulation is Gaussian frequency-shift keying (GFSK). It can achieve a gross data rate of 1 Mbit/s.

Enhanced data rate (EDR) is an enhancement to the *Bluetooth* Core Specification version 1.2 (v1.2) and is described in the *Bluetooth* version 2.0 specification. It uses $\pi/4$ -DQPSK and 8DPSK modulation giving 2 and 3 Mbit/s data transfer rates, respectively.

Bluetooth low energy (LE) technology was finalized in December 2009 by the *Bluetooth* SIG. This ultra low power *Bluetooth* technology is intended to discover new use case scenarios for tiny low power devices that were not served by existing local connectivity solutions. Two modes have been designed: single-mode and dual mode. The *Bluetooth* low energy dual-mode chips support both *Bluetooth* low energy and Classic *Bluetooth* technology; single-mode chips support only *Bluetooth* low energy. The low energy wireless technology is part of the Core Specification v4.0.

Additionally, the *Bluetooth* new Core Specification version 2.1 + EDR, has been published by the SIG with security improvements, simplified pairing and power consumption. These will offer more advances in short range wireless technology and make it easier for consumers to connect.

Table 1. Key *Bluetooth* parameters

| | <i>Bluetooth</i> (Basic rate) | <i>Bluetooth</i> (Enhanced data rate) | <i>Bluetooth</i> (Low energy) |
|------------------------------|--|--|--|
| Frequency range ¹ | 2400 to 2483.5 MHz | 2400 to 2483.5 MHz | 2400 to 2483.5 MHz ² |
| Modulation | GFSK | Header: GFSK Data: $\pi/4$ -DQPSK, 8DPSK | GFSK |
| Frequency hopping | FHSS with 1600 hops/s (in normal operation) ³ | FHSS with 1600 hops/s (in normal operation) ³ | FHSS with 1600 hops/s (in normal operation) ³ |
| Duplex method | TDD | TDD | TDD |
| Channel spacing | 1 MHz | 1 MHz | 2 MHz |
| Data rate | 1 Mbps | 2 to 3 Mbps | 1 Mbps |

1. The *Bluetooth* specification includes a special frequency hopping pattern to provide provisions for compliance with national limitations such as those in France. The frequency range for France is 2445.4 to 2483.5 MHz and the corresponding RF channels are $f = 2454 + k$ MHz, $K = 0, \dots, 22$.
2. The *Bluetooth* low energy system uses center frequencies $2402 + k \times 2$ MHz ($k = 0 \dots 39$).
3. Hop speed may vary, depending on packet length

RF Transmitter Tests

With the X-Series signal analyzers and the *Bluetooth* measurement application, you can perform the RF layer test procedure and specification (TSS/TP⁴).

Standard-based RF transmitter tests

The *Bluetooth* specifications are developed and licensed by the *Bluetooth* Special Interest Group (SIG). The *Bluetooth* Test Specification document contains the Test Suite Structure (TSS) and Test Purpose (TP)

to test the *Bluetooth* RF layer including Enhanced Data Rate. This specification is a basis for conformance tests of *Bluetooth* devices, giving a high probability of air interface interoperability between different manufacturer's *Bluetooth* devices. For the *Bluetooth* low energy, it is integrated into an existing Classic *Bluetooth* controller, so its architecture shares much of Classic *Bluetooth*'s existing radio and functionality resulting in a minimal cost increase compared to Classic *Bluetooth*.

The Keysight X-Series *Bluetooth* measurement application refers to the following *Bluetooth* RF test specifications:

- *Bluetooth* Test Specification 1.2/2.0/2.0+EDR/2.1/2.1+DER
- *Bluetooth* Low Energy RF Test Specifications: RF-PHY.TS/4.0.0

Table 2 provides a list of tests with their test purpose identifiers and corresponding measurement applications for transmitter tests only.

Table 2. *Bluetooth* RF transmitter measurements and the corresponding measurements in N/W9081A and ESA-E spectrum analyzer

| <i>Bluetooth</i> transmitter tests | Identifier ² | N/W9081A X-Series measurement application | ESA-E Series spectrum analyzer |
|---|-------------------------|---|--------------------------------|
| Basic rate | | | |
| Output power | TRM/CA/01/C | Transmit analysis | Output power |
| Tx output spectrum –20 dB bandwidth | TRM/CA/05/C | Output spectrum bandwidth | Output spectrum bandwidth |
| Tx output spectrum – adjacent channel power | TRM/CA/06/C | Adjacent channel power | Adjacent channel power |
| Modulation characteristics | TRM/CA/07/C | Transmit analysis | Modulation characteristic |
| Initial carrier frequency tolerance | TRM/CA/08/C | Transmit analysis | Modulation characteristic |
| Carrier frequency drift | TRM/CA/09/C | Transmit analysis | Modulation characteristic |
| Enhanced data rate (EDR) | | | |
| EDR relative transmit power | TRM/CA/10/C | Transmit analysis | |
| EDR carrier frequency stability and modulation accuracy | TRM/CA/11/C | Transmit analysis | |
| EDR differential phase encoding | TRM/CA/12/C | Transmit analysis | |
| EDR in-band spurious emissions | TRM/CA/13/C | EDR in-band spurious emissions | |
| Low Energy (LE) or Ultra Low Power (ULP) | | | |
| Output power at NOC | TRM-LE/CA/01/C | Transmit analysis | |
| Output power at EOC | TRM-LE/CA/02/C | Transmit analysis | |
| In-band emission at NOC | TRM-LE/CA/03/C | LE in-band emission | |
| In-band emission at EOC | TRM-LE/CA/04/C | LE in-band emission | |
| Modulation characteristics | TRM-LE/CA/05/C | Transmit analysis | |
| Carrier frequency offset and drift at NOC | TRM-LE/CA/06/C | Transmit analysis | |
| Carrier frequency offset and drift at EOC | TRM-LE/CA/07/C | Transmit analysis | |

1. Radio frequency Test Suite Structure (TSS) and Test Purposes (TP) system specifications

2. Identifier format is: (Test)/CA/NN/C, in which

TRM = Transmitter test

CA = Capability test (defines the type of testing)

NN = Test purpose number

C = Conformance test performed on dedicated *Bluetooth* test system

Measurement details

All of the *Bluetooth* RF transmitter measurements as defined for basic, EDR and low energy in the test specifications, as well as a wide range of additional measurements and analysis tools, are available with a press of a button (Table 3). These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands.

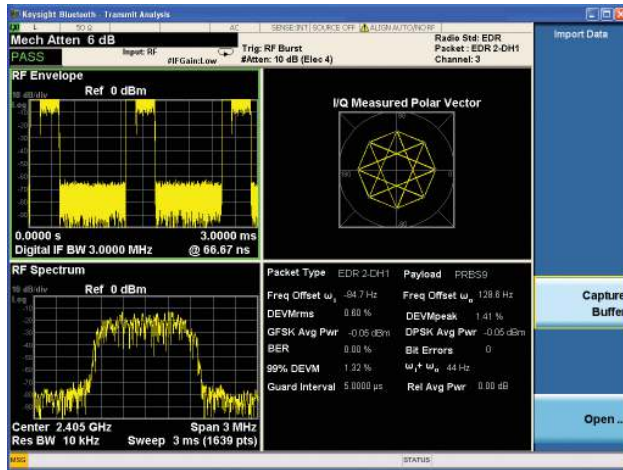


Figure 1. Transmit analysis for EDR signal

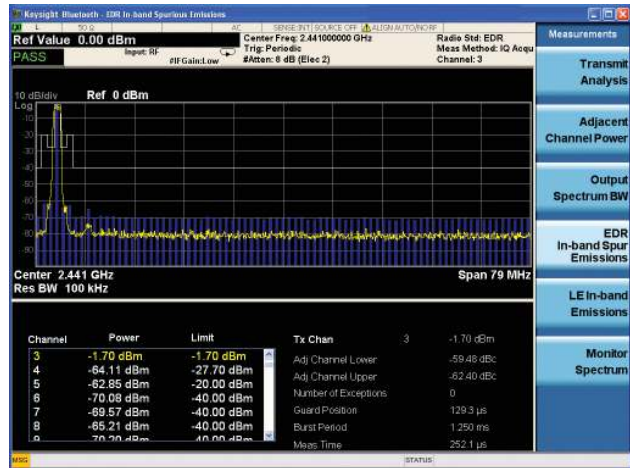


Figure 3. EDR in-band emission

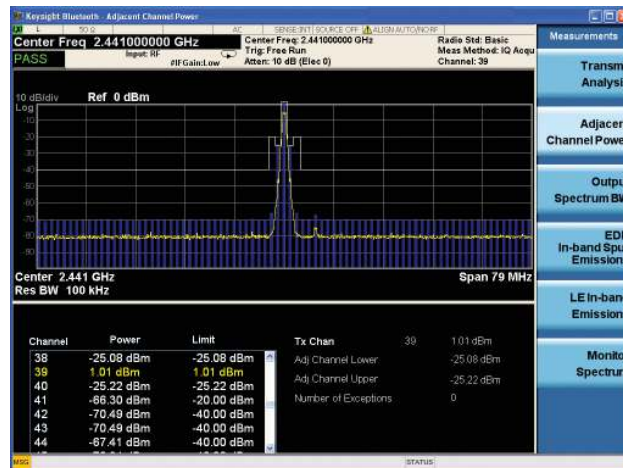


Figure 2. Adjacent channel power for basic rate Bluetooth signal

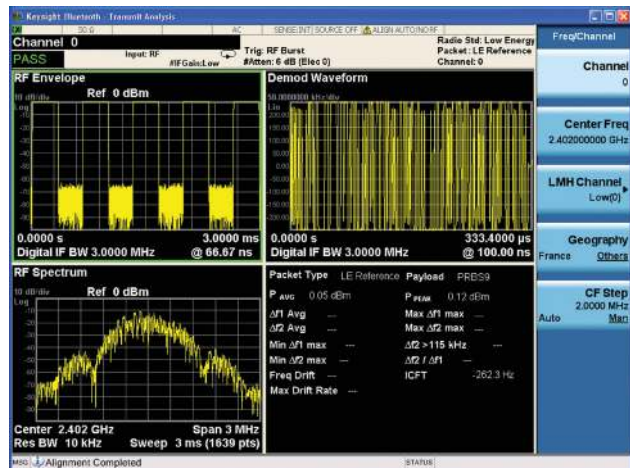


Figure 4. Transmit analysis for low energy (LE) signal

Measurement details (continued)

Table 3. One-button measurements provided by the N/W9081A measurement application

| Bluetooth Technology | Basic data rate | Enhanced data rate | Low energy |
|---|---------------------------|---------------------------|---------------------------|
| X-Series measurement application | N9081A, W9081A | N9081A, W9081A | N9081A, W9081A |
| X-Series signal analyzer | PXA, MXA, EXA, CXA | PXA, MXA, EXA, CXA | PXA, MXA, EXA, CXA |
| Transmit analysis | | | |
| Output power (in time domain) | | | |
| Peak power | • | | • |
| Average power | • | | • |
| Modulation characteristics | | | |
| $\Delta F1$ avg (11110000) | • | | • |
| $\Delta F2$ avg (10101010) | • | | • |
| Min $\Delta f1$ / $\Delta f2$ max, | • | | • |
| Max $\Delta F1$ / $\Delta F2$ max, | • | | • |
| $\Delta F2 > 115$ kHz | • | | • |
| $\Delta F2/\Delta F1$ ratio | | | |
| Initial carrier frequency tolerance (ICFT) | • | | • |
| Carrier frequency drift | | | |
| Frequency drift | • | | • |
| Max drift rate | • | | • |
| Adjacent channel power | • | | |
| Output power – 20 dB bandwidth | • | | |
| EDR transmit analysis | | | |
| Relative transmit power | | | |
| GFSK average power | | • | |
| DPSK average power | | • | |
| Relative power | | • | |
| Frequency stability and modulation accuracy | | | |
| Freq offset ω_i/ω_0 , $\omega_{i+\omega_0}$ | | • | |
| RMS DEVM (differential DVM) | | • | |
| Peak DEVM | | • | |
| Differential phase decoding | | | |
| BER | | • | |
| Bit error | | • | |
| 99% DEVM | | • | |
| EDR in-band spurious emissions | | • | |
| LE in-band emissions | | | • |

Key Specifications

Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- 95th percentile values indicate the breadth of the population ($\approx 2\sigma$) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.
- Typical values are designated with the abbreviation “typ.” These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.
- Nominal values are designated with the abbreviation “nom.” These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- PXA specifications apply to analyzers with frequency options of 526 and lower. For analyzers with higher frequency options, specifications are not warranted but performance will nominally be close to that shown in this section.

Note: Data subject to change

You Can Upgrade!

Options can be added after your initial purchase.



All of our X-Series application options are license-key upgradeable.

Supported devices and standard version

| Device type | Bluetooth devices |
|------------------|---|
| Standard version | <i>Bluetooth</i> radio frequency system specification 1.2/2.0/2.0+EDR/2.1/2.1+EDR revision 2.1.E.0 - basic rate - enhanced data rate <i>Bluetooth</i> Low Energy RF PHY test specification (LE RF-PHY.TS/4.0.0) |
| Power classes | Class 1, class 2 and class 3 |
| Radio band | <i>Bluetooth</i> basic rate and EDR system: 2.400 to 2.4835 GHz ($f = 2402 + k$ MHz, $k = 0, \dots, 78$) <i>Bluetooth</i> low energy system: 2.400 to 2.4835 GHz ($f = 2402 + k \times 2$ MHz, $k = 0, \dots, 39$) |

For a complete list of specifications refer to the appropriate specifications guide.

PXA: www.keysight.com/find/pxa_specifications

MXA: www.keysight.com/find/mxa_specifications

EXA: www.keysight.com/find/exa_specifications

CXA: www.keysight.com/find/cxa_specifications

Performance specifications

| Supported standards | | | | |
|--|---|-----------------|-----------------|-----------------|
| Bluetooth basic rate | Revision 2.1.E.0 | | | |
| Bluetooth Enhanced Data Rate | Revision 2.1.E.0 | | | |
| Bluetooth Low Energy | LE. RF-PHY.TS/4.0.0 | | | |
| Description | PXA | MXA | EXA | CXA |
| Basic rate or Low energy measurements | | | | |
| Output power | | | | |
| Packet type | DH1, DH3, DH5, HV3 | | | |
| Payload | PRBS9, BS00, BSFF, BS0F, BS55 | | | |
| Synchronization | RF Burst or Preamble | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Supported measurements | Average power, peak power | | | |
| Range | +30 dBm to -70 dBm | | | |
| Absolute power accuracy | ± 0.20 dB (95%) | ± 0.25 dB (95%) | ± 0.29 dB (95%) | ± 0.61 dB (95%) |
| Measurement floor | -70 dBm (nom) | | | |
| Modulation characteristics | | | | |
| Packet type | DH1, DH3, DH5, HV3 (for Basic), Reference packet (for LE) | | | |
| Payload | BS0F, BS55 | | | |
| Synchronization | Preamble | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Supported measurements | <i>Min/max Δf_{1avg}, min Δf_{2max} (kHz), total $\Delta f_{2max} > \Delta f_{2max}$ lower limit (%), min of min $\Delta f_{2avg}/max \Delta f_{1avg}$, pseudo frequency deviation (Δf_1 and Δf_2)</i> | | | |
| RF input level range | +30 dBm to -70 dBm | | | |
| Deviation range | ± 250 kHz (nom) | | | |
| Deviation resolution | 100 Hz (nom) | | | |
| Measurement accuracy | ± 100 Hz + tfa ¹ (nom) | | | |
| Initial carrier frequency tolerance | | | | |
| Packet type | DH1, DH3, DH5, HV3 (for Basic), Reference packet (for LE) | | | |
| Payload | PRBS9, BS00, BSFF, BS0F, BS55 | | | |
| Synchronization | Preamble | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| RF input level range | +30 dBm to -70 dBm | | | |
| Measurement range | Nominal channel freq ± 100 kHz (nom) | | | |
| Measurement accuracy | ± 100 Hz + tfa ¹ (nom) | | | |
| Carrier frequency drift | | | | |
| Packet type | DH1, DH3, DH5, HV3 (for Basic), Reference packet (for LE) | | | |
| Payload | PRBS9, BS00, BSFF, BS0F, BS55 | | | |
| Synchronization | Preamble | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| RF input level range | +30 dBm to -70 dBm | | | |
| Measurement range | ± 100 kHz (nom) | | | |
| Measurement accuracy | ± 100 Hz + tfa ¹ (nom) | | | |
| Adjacent channel power² (Basic Rate) | | | | |
| Packet type | DH1, DH3, DH5, HV3 | | | |
| Payload | PRBS9, BS00, BSFF, BS0F, BS55 | | | |
| Synchronization | None | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Absolute power accuracy | Dominated by the variance of measurements ⁴ | | | |
| LE in-band emission³ (Low Energy) | | | | |
| Packet type | Reference packet | | | |
| Payload | PRBS9, BS00, BSFF, BS0F, BS55 | | | |
| Synchronization | None | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Absolute power accuracy | Dominated by the variance of measurements ⁴ | | | |

Performance specifications (continued)

| Description | PXA | MXA | EXA | CXA |
|---|--|-----------------|-----------------|-----------------|
| Enhanced data rate (EDR) measurements | | | | |
| EDR relative transmit power | | | | |
| Packet type | 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5 | | | |
| Payload | PRBS9, BS00, BSFF, BS0F, BS55 | | | |
| Synchronization | DPSK synchronization sequence | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Supported measurements | Power in GFSK header, power in PSK payload, relative power between GFSK header and PSK payload | | | |
| RF input level range | +30 dBm to -70 dBm | | | |
| Absolute power accuracy | ± 0.20 dB (95%) | ± 0.25 dB (95%) | ± 0.29 dB (95%) | ± 0.61 dB (95%) |
| Measurement floor | -70 dBm (nom) | | | |
| EDR modulation accuracy | | | | |
| Packet type | 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5 | | | |
| Payload | PRBS9, BS00, BSFF, BS55 | | | |
| Synchronization | DPSK synchronization sequence | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Supported measurements | rms DEVM, peak DEVM, 99% DEVM | | | |
| RF input level range | +30 dBm to -70 dBm | | | |
| Range (rms DEVM) | 0 to 12% | | 0 to 12% (nom) | |
| Floor | 1.5% | | 1.6% (nom) | |
| Accuracy | ± 1.2% ⁵ | | | |
| EDR carrier frequency stability | | | | |
| Packet type | 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5 | | | |
| Payload | PRBS9, BS00, BSFF, BS55 | | | |
| Synchronization | DPSK synchronization sequence | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Supported measurements | Worst case initial frequency error(ω_i) for all packets (carrier frequency stability), worst case frequency error for all blocks (ω_o), ($\omega_o + \omega_i$) for all blocks | | | |
| RF input level range | +30 dBm to -70 dBm | | | |
| Carrier frequency stability and frequency error | ± 100 Hz + tfa^1 (nom) | | | |
| EDR in-band spurious emissions | | | | |
| Packet type | 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5 | | | |
| Payload | PRBS9, BS00, BSFF, BS55 | | | |
| Synchronization | DPSK synchronization sequence | | | |
| Trigger | External, RF Burst, Periodic Timer, Free Run, Video | | | |
| Measurement accuracy | | | | |
| offset freq = 1 MHz to 1.5 MHz | Dominated by the ambiguity of the measurement standards ⁶ | | | |
| offset freq = other offset (2 MHz to 78 MHz) | Dominated by the variance of measurements ⁴ | | | |

1. $tfa = \text{transmitter frequency} \times \text{frequency reference accuracy}$.

2. The accuracy is for absolute power measured at 2.0 MHz offset and other offsets (offset = K MHz, K = 3, ..., 78).

3. The accuracy is for absolute power measured at 2.0 MHz offset and other offsets (offset = 2 MHz * K, K = 2, ..., 39).

4. The measurement at these offsets is usually the measurement of noise-like signals and therefore has considerable variance. For example, with 100 ms sweeping time, the standard deviation of the measurement is about 0.5 dB. In comparison, the computed uncertainties of the measurement for the case with CW interference is only ± 0.20 dB (PXA), ± 0.25 dB (MXA), ± 0.29 dB (EXA), ± 0.61 dB (CXA) (95th percentile).

5. The accuracy specification applies when the EVM to be measured is well above the measurement floor. Please refer to Bluetooth specification guide for N9081A or W9081A for more detail explanation.

6. The measurement standards call for averaging the signal across 3.5 μ s apertures and reporting the highest result. For common impulsive power at these offsets, this gives a variation of result with the time location of that interference that is 0.8 dB peak-to-peak and changes with a scallop shape with a 3.5 μ s period. Uncertainties in the accuracy of measuring CW-like relative power at these offsets are nominally only ± 0.03 dB (PXA), ± 0.07 dB (MXA), ± 0.09 dB (EXA), ± 0.11 dB (CXA), but observed variations of the measurement algorithm used with impulsive interference are similar to the scalloping error.

Ordering Information

Software licensing and configuration

Choose from two license types:

- Fixed, perpetual license:
This allows you to run the application in the X-Series analyzer in which it is initially installed.
- Transportable, perpetual license:
This allows you to run the application in the X-Series analyzer in which it is initially installed, plus it may be transferred from one X-Series analyzer to another.

Try Before You Buy!

Free 30-day trials of X-Series measurement applications provide unrestricted use of each application's features and functionality on your X-Series analyzer. Redeem a trial license online today:
www.keysight.com/find/X-Series_trial

One Button Transmit Analysis Provides Multiple Results

The measurement sequence performed by the analyzer can accommodate any mix of transmitter power measurements and modulation quality measurements performed on the data collected within the capture period.

The table below contains information on our fixed, perpetual licenses. For more information, please visit the product web pages.

N9081A & W9081A Bluetooth X-Series measurement application

| Description | Model-Option | Model-Option |
|------------------|---------------|--------------|
| | PXA, MXA, EXA | CXA |
| <i>Bluetooth</i> | N9081A-2FP | W9081A-2FP |

X-Series Measurement Application Updates

To update a previously purchased N9081A/W9081A measurement application to include the latest feature updates, you can purchase the N9081A-MEU or W9081A-MEU minor enhancement update.

For more information, visit:

www.keysight.com/find/N9081A-MEU for PXA, MXA, EXA

www.keysight.com/find/W9081A-MEU for CXA

Hardware configuration

N9030A PXA signal analyzer

| Description | Model-Option | Additional information |
|---|---|------------------------|
| 3.6, 8.4, 13.6, 26.5, 43, 44, or 50 GHz frequency range | N9030A-503, -508, -513, -526, -543, -544 or -550 | One required |
| Precision frequency reference | N9030A-PFR | Recommended |
| Electronic attenuator, 3.6 GHz | N9030A-EA3 | Recommended |
| Preamplifier, 3.6, 8.4, 13.6, 26.5, 43, 44 or 50 GHz | N9030A – P03, -P08, -P13, -P26, -P43, -P44 or P50 | One recommended |

N9020A MXA signal analyzer

| Description | Model-Option | Additional information |
|---|--------------------------------|------------------------|
| 3.6, 8.4, 13.6, or 26.5 GHz frequency range | N9020A-503, -508, -513 or -526 | One required |
| Precision frequency reference | N9020A-PFR | Recommended |
| Electronic attenuator, 3.6 GHz | N9020A-EA3 | Recommended |
| Preamplifier, 3.6, 8.4, 13.6 or 26.5 GHz | N9020A-P03, -P08, -P13 or -P26 | One recommended |

N9010A EXA signal analyzer

| Description | Model-Option | Additional information |
|--|--|------------------------|
| 3.6, 7.0, 13.6, 26.5, 32 or 44 GHz frequency range | N9010A-503, -507, -513, -526, -532 or -544 | One required |
| Precision frequency reference | N9010A-PFR | Recommended |
| Fine step attenuator | N9010A-FSA | Recommended |
| Electronic attenuator, 3.6 GHz | N9010A-EA3 | Recommended |
| Preamplifier, 3.6, 7.0, 13.6 or 26.5 GHz | N9010A-P03, -P07, -P13 or -P26 | One recommended |

N9000A CXA signal analyzer

| Description | Model-Option | Additional information |
|---|---------------------------------|------------------------|
| 3.0, 7.5, 13.6, or 26.5 GHz frequency range | N9000A-503, -507, -513, or -526 | One required |
| Fine step attenuator | N9000A-FSA | Recommended |
| Preamplifier, 3.0, 7.5, 13.6, or 26.5 GHz | N9000A-P03, -P07, -P13, or -P26 | One recommended |

Related Literature

N9081A & W9081A Bluetooth, Self-Guide Demonstration,
Literature Number 5990-6161EN

Bluetooth Measurement Fundamentals, Application Note,
Literature Number 5988-3760EN

Verifying Bluetooth Baseband Signals using Mixed Signal Oscilloscopes, Application Note AN 1333-3,
Literature Number 5988-2181EN

Keysight E4438C Signal Studio for Bluetooth, Application Note 1421,
Literature Number 5988-5417EN

Keysight Innovative Solution for Testing Bluetooth Enhanced Data Rate Products, Product Overview,
Literature Number 5989-3055EN

User's and Programmer's Reference Guide is available in the library section of the N9083A and W9083A product pages.

Web

Product page:

www.keysight.com/find/N9081A and www.keysight.com/find/W9081A

X-Series measurement applications:

www.keysight.com/find/X-Series_Apps

X-Series signal analyzers:

www.keysight.com/find/X-Series

Application pages:

www.keysight.com/find/bluetooth

myKeysight

myKeysight

www.keysight.com/find/mykeysight

A personalized view into the information most relevant to you.



www.lxistandard.org

LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.



Three-Year Warranty

www.keysight.com/find/ThreeYearWarranty

Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.



Keysight Assurance Plans

www.keysight.com/find/AssurancePlans

Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.



www.keysight.com/go/quality

Keysight Technologies, Inc.

DEKRA Certified ISO 9001:2008

Quality Management System

Keysight Channel Partners

www.keysight.com/find/channelpartners

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